OIL AND VACUUM PUMPS GROUP FOR A MOTOR VEHICLE ENGINE

DESCRIPTION

The present invention relates to an oil and vacuum pumps group for a motor vehicle engine. More specifically, the invention relates, preferably but not exclusively, to an oil and vacuum pumps group for an endothermic engine for heavy motor vehicles, such as buses, trucks and the like, and/or for medium-high powered motor vehicles.

The invention also relates to a method for assembling an oil and vacuum pumps group in accordance with the present invention and to a motor vehicle engine comprising such an oil and vacuum pumps group.

As is known, the engines of motor vehicles, above all of heavy motor vehicles and/or high powered motor vehicles, typically comprise an oil pump, adapted to pump pressurised oil for lubricating the engine, and a vacuum pump, adapted to provide for a determined depression for the activation and operation of special features provided within the motor vehicle, such as the servo brake.

Generally, the oil pump and the vacuum pump are units which are structurally independent from each other and with respect to the engine block; such units are fitted on respective transmission shafts which are driven into rotation separately through respective and distinct actuation members (for example, the oil pump can be driven by the crankshaft of the engine and the vacuum pump can be driven by a camshaft).

In some prior art embodiments, the transmission shafts of the oil pump and of the vacuum pump are parallel an kinematically associated with each other so as to be capable of being driven into rotation through a single actuation member (for example through a gear group which derives its motion from the crankshaft of the engine, such a gear group comprising a first sprocket associated with

the crankshaft of the engine and a second sprocket fitted onto the transmission shaft of the oil pump and kinematically connected, directly or through the interposition of belts or chains, to a third sprocket fitted onto the transmission shaft of the vacuum pump).

In all of the technical solutions described above, the provision of distinct transmission shafts for the oil pump and the vacuum pump and of respective actuation members for rotating such shafts (when the two shafts are driven independently from each other) or for the kinematic connection between such shafts (when the two shafts are driven through a single actuation member) inevitably implies problems of bulk and weight, due to the high number of mechanical elements or members used and their mutual positioning. Consequently, the assembly and/or installation operations of the oil pump and of the vacuum pump in the engine are also particularly burdensome.

To overcome the aforementioned problems, US 6,345,600 provides an oil and vacuum pumps group in which the rotors of the oil pump and of the vacuum pump are fitted on a single motion transmission shaft driven into rotation by a single gear arranged at the shaft front end and in which the stators of the oil pump and of the vacuum pump are defined by a single housing provided in the engine block. Thus, this is an oil and vacuum pumps group in which oil pump and vacuum pump are integrated in the engine block. In other words, this group consists of a single component which, only when integrated in engine block, carries out the dual function of oil pump and vacuum pump. The provision of a single motion transmission shaft and the integration of the oil and vacuum pumps group in the engine block clearly allows to achieve a reduction in weight and bulk of the oil and vacuum pumps group, at the same time making the assembly and/or installation operations simpler and faster.

The solution proposed in US 6,345,600, although

advantageous for achieving the purposes foreseen and above identified, does however have some drawbacks. First of all, the choice of integrating the oil and vacuum pumps group in the engine block requires special technical provisions to be arranged in the engine block, in particular suitable housings or seats for the rotors of the oil pump and of the vacuum pump must be provided in the engine block. This involves, on the one hand, a complication of the design and manufacturing operations of the engine block and, on the other hand, clear limits in terms of interchangeability and flexibility in the combined use of the engine and of the oil and vacuum pumps group, or else the impossibility of using a single engine for different types of oil and vacuum pumps groups or vice-versa (one thinks, for example, that different sizes of the rotors of the oil pump and of the vacuum pump could require different sizes of the respective stators, and thus different sizes of the housings arranged in the engine block). Moreover, the integration of the oil and vacuum pumps group in the engine block implies the risk of damaging, during the assembly and/or installation and/or maintenance operations of the oil and vacuum pumps group, the walls of the housings suitably provided in the engine block and acting as a stator for the oil pump and for the vacuum pump, with the consequent need for intervention on such walls through subsequent rectification operations. The assembly, disassembly and maintenance operations of the oil and vacuum pumps group are thus particularly delicate, precisely due to the risk of damaging the engine block.

The technical problem at the basis of the present invention is that of providing an oil and vacuum pumps group which overcomes the drawbacks outlined above with reference to the prior art; in particular, the object of the present invention is that of providing an oil and vacuum pumps group which, besides being structurally and functionally simple, can ensure the desired features of interchangeability and flexibility in the combined use with an engine for motor vehicles and of speed and/or simplicity

in the assembly and installation operations, at the same time ensuring bulk reduction.

Therefore, the present invention relates, in a first aspect thereof, to an oil and vacuum pumps group for a motor vehicle engine, comprising:

- at least one motion transmission shaft extending along a main axis X-X;
- at least one oil pump fitted on said at least one motion transmission shaft;
- at least one vacuum pump fitted onto said at least one motion transmission shaft;
- a gear fitted onto said at least one motion transmission shaft and adapted to derive a rotary motion from a driving gear of a motor vehicle engine and to transfer said rotary motion to said at least one motion transmission shaft to drive said at least one oil pump and said at least one vacuum pump;

characterised in that the group is structurally independent from and adapted to be associated with said motor vehicle engine.

Throughout the present description and the subsequent claims, the term "gear" is used to indicate any conventional mechanical member adapted to derive the motion from a different mechanical member and to transfer it to a further mechanical member. Preferably, the gear of the oil and vacuum pumps group of the present invention consists of a sprocket adapted to engage directly with a driving gear associated with the crankshaft of the motor vehicle engine. Alternatively, the deriving of motion from the driving gear can take place indirectly through the interposition of belts or chains.

Advantageously, the oil and vacuum pumps group of the present invention is a structurally and functionally free-standing component with respect to the engine, i.e. a component which is structurally and functionally independent from the engine. Such a component can be

associated with and detached from the engine; it can therefore be used indistinctly in combination with a plurality of different engines, since it is not necessary to provide the engine with suitable housings for the oil pump and/or vacuum pump. It is thus a components which is extremely interchangeable and flexible in use.

Even more advantageously, since the installation of the oil and vacuum pumps group of the present invention does not require any prior intervention on the engine with which said group is adapted to be associated (except that of providing the engine with conventional attachment means of the group of the invention), the installation operations are extremely simple and fast, as well as the disassembly and maintenance operations of the group. Such operations, in any case, do not in any way involve the structure of the engine, which thus does not run the risk of being damaged or compromised.

Moreover, the choice of an aligned configuration of the oil pump and vacuum pump and of a single gear for driving the oil pump and the vacuum pump allows the number of mechanical elements used to be limited, thus giving the desired reduction in bulk and weight.

Preferably, said at least one oil pump and said at least one vacuum pump are units which are structurally independent from each other. The oil and vacuum pumps group of the present invention therefore consists of a modular combination of at least one oil pump, at least one vacuum pump and a motion deriving gear, all of the conventional type. Advantageously, such modularity allows to achieve clear advantages in terms of interchangeability of the individual components, namely the oil pump, the vacuum pump and the gear, as well as to achieve many advantages in the assembly, disassembly and maintenance operations of the aforementioned components.

Preferably, said gear is operatively placed between said at

least one oil pump and said at least one vacuum pump. Such a constructive configuration is particularly advantageous for those particular engines in which it is necessary to meet precise restrictions in terms of bulk and layout. In particular, such a constructive configuration is particularly advantageous for 4 X 4 engines, or engines for four-wheel drive motor vehicles, where it is necessary to provide for a suitable motion transmission shaft for the front drive wheels of the vehicle. Indeed, in such engines, considering the structural restriction given by the positioning of the driving gear from which the motion is derived, the fact of positioning the gear of the oil and vacuum pumps group between the oil pump and the vacuum pump ensures that, once the oil and vacuum pumps group is installed in the engine with its own gear positioned at the driving gear, the vacuum pump is arranged in a space which typically is unused (the space downstream of the gear and defined in the corner between the oil sump and the engine front end), thus recovering a corresponding axial space upstream of the gear. Such a recovered space can advantageously be used for other purposes, such as for the passage of the shaft for motion transmission to the front drive wheels of the motor vehicle.

Preferably, said at least one oil pump is a single-stage pump, but alternatively a two-stage pump can be provided. The man skilled in the art shall understand that it is also foreseeable to use more than one oil pump and more than one vacuum pump in line (should a plurality of different applications or features be slaved) whilst still remaining within the scope of protection of the present invention as claimed hereafter.

Preferably, the oil and vacuum pumps group of the present invention also comprises means for the attachment to an engine block. More preferably, said means for the attachment to an engine block comprises a plurality of brackets adapted to cooperate with respective brackets

formed on said engine block. In any case, these are conventional means which, when associated with the oil and vacuum pumps group of the present invention, allow to achieve the desired advantages of constructive simplicity and simplicity/speed of execution of the assembly and disassembly operations of the group of the invention in and from the engine.

Preferably, said at least one oil pump and said at least one vacuum pump are fitted onto a single motion transmission shaft. Such a solution is particularly preferred since it allows the number of mechanical elements used, and thus the weight and bulk of the oil and vacuum pumps group of the invention, to be limited. In a less preferred alternative embodiment, said at least one oil pump and said at least one vacuum pump are fitted respectively on a first and second motion transmission shafts, said first and second motion transmission shafts being kinematically associated with said gear and aligned along said axis X-X.

In a second aspect thereof, the present invention relates to a method for assembling an oil and vacuum pumps group for a motor vehicle engine, comprising the steps of:

a) providing at least one motion transmission shaft;
b) providing at least one oil pump;
c) providing at least one vacuum pump;
d) providing a gear;
e) fitting said gear, said at least one oil pump and said at least one vacuum pump on said at least one motion transmission shaft;

characterised in that the step e) of fitting said gear, said at least one oil pump and said at least one vacuum pump on said at least one motion transmission shaft comprises the step of positioning said gear between said at least one oil pump and said at least one vacuum pump.

The execution of such a method allows to achieve all of the advantages outlined above with reference to the oil and

vacuum pumps group of the present invention.

In a third aspect thereof, the present invention relates to a motor vehicle engine comprising an oil and vacuum pumps group of the type described above.

Such an engine has all of the advantages outlined above with reference to the oil and vacuum pumps group of the present invention.

Further characteristics and advantages of the present invention shall become clearer from the following detailed description of a preferred embodiment thereof made with reference to the attached drawings without any limiting purpose and only by way of illustration. In such drawings:

- figure 1 is a perspective view of an oil and vacuum pumps group in accordance with the present invention;
- figure 2 is an exploded perspective view of the oil and vacuum pumps group of figure 1;
- figure 3 is a schematic section view of the oil and vacuum pumps group of figure 1 associated with an engine block, the latter being shown only in part.

In such figures, an oil and vacuum pumps group in accordance with the present invention is indicated with 1. It is an oil and vacuum pumps group for a motor vehicle engine, particularly for an endothermic engine for heavy motor vehicles, such as buses, trucks and the like, and/or for medium-high powered motor vehicles.

It shall become clearer in the rest of the present description that the use of the group of the present invention is particularly advantageous in 4 X 4 engines for four-wheel drive motor vehicles.

In figure 3 a portion of the engine block with which the group 1 of the present invention is associated is indicated with 2. Further, the crankcase is indicated with 200.

The group 1 comprises an oil pump 10 (which can

indistinctly be a single-stage or two-stage pump) and a vacuum pump 20 both fitted on a single motion transmission shaft, indicated in figures 2 and 3 with 30, extending along a main axis X-X. A gear 40, specifically a sprocket, is also fitted onto the motion transmission shaft 30; the gear 40 is placed between the oil pump 10 and the vacuum pump 20 and is adapted to engage with a driving gear, indicated with 41 in figure 3, associated with the crankshaft of the motor vehicle, so as to derive the rotary motion from the engine and transfer it to the transmission shaft 30 of the group 1 in order to drive the oil pump 10 and the vacuum pump 20.

The oil pump 10, the vacuum pump 20, the motion transmission shaft 30, the gear 40, the driving gear 41 and the engine itself are all components which are structurally independent from each other and of the conventional type. Therefore, they shall not be described in detail in this context. In the attached figures 1-3 it is possible to see the rotor 11 of the oil pump 10 (figures 2 and 3), the stator 12 of the oil pump 10, the cover 13 of the oil pump 10, the blade 21 of the vacuum pump 20 (figures 2 and 3), the stator 22 of the vacuum pump 20 and the cover 23 of the vacuum pump 20.

The oil pump 10, the vacuum pump 20, the motion transmission shaft 30 and the gear 40 can be assembled and combined in a modular manner so as to form the group 1 of the present invention.

In the assembly step of the group 1 of the present invention, the oil pump 10, the gear 40 and the vacuum pump 20 are fitted in succession onto the motion transmission shaft 30 (in the order indicated above or in reverse order). The group 1 at this point is assembled and ready to be installed in the motor vehicle engine.

Once assembled, the oil and vacuum pumps group 1 of the present invention is a structurally and functionally free-

standing component with respect to the engine, with which it is intended to be removably associated through suitable brackets 50 adapted to cooperate with corresponding brackets (not illustrated) formed in the engine block 2.

In the installation step of the group 1 in the motor vehicle engine, the restriction to be met is the positioning of the gear 40 at the driving gear 41 from which the motion must be derived. By doing so the group 1 of the present invention, once associated with the engine, is positioned in such a way that the vacuum pump 20 is arranged in a space 210 downstream of the gear 40. Such a space corresponds to the angle between the oil sump and the engine front end; in the engines of the prior art such a space, which in any case is present, is typically unused. Therefore, a corresponding axial space upstream of the gear 40 is advantageously recovered, such a recovered space being advantageously usable for other purposes. For example, in 4 x 4 engines, such a recovered axial space upstream of the gear 40 can be used for the passage of the shaft for the motion transmission to the front drive wheels of the motor vehicle.

Of course, a man skilled in the art will recognise that it is possible to foresee various alternative embodiments of the constructive elements of the group of the present invention (for example, the type of oil pump and vacuum pump, the methods of kinematic connection between the motion transmission shaft of the group and the driving gear, etc.) without for this reason departing from the scope of protection of the invention which is defined by the subsequent claims.